19

Diesel Railway Traction

British Express Railcars

ALTHOUGH the Great Western Railway was not first among the British group companies in giving a trial to diesel traction, it has just given convincing proof of its confidence in the ability of oil-engined vehicles to maintain important services by ordering six fast railcars from the Associated Equipment Company, the firm that was responsible for the 130 b.h.p. railcar which has been running in the Thames valley since February. The new cars are destined for the Birmingham-Cardiff line, where the first two will be put into operation on supplementary services with the inauguration of the summer timetables on July 9. A third car will be held in reserve, and the last three cars will be put into a similar type of service before the end of the year. Great credit is reflected on the builders by the manner in which they have turned out railcars of a new design in so short a time, for the order was not passed until February last. Although the original 130 b.h.p. A.E.C. car served as a basis for the present design, many of the features are quite different, and the layout and operation of the two engines which were found necessary for the attainment of speeds up to 80 m.p.h. are noteworthy. The arrangement of the power units and transmission has been given a great deal of attention to ensure simplicity and reliability of operation and to obtain easy access to all the working parts, and the manner in which this has been done is described on another page of this issue.

The bookings for the services operated by these cars will be definitely limited to the number of seats, but a new feature so far as British railway operation is concerned is that a supplementary fee will be charged for a non-Pullman train, and apparently the one fee of 2s. 6d. will cover a single journey between the two terminals, or from either of them to Gloucester. Local passengers will not be carried between Cardiff and Newport. The practice of serving meals on a diesel train in England is not quite new, as the Armstrong-Shell express which ran from Euston to Birmingham for the duration of the British Industries Fair in 1933 was fitted up as a restaurant car, but the vehicles under consideration are the first British diesel units to be definitely fitted up as buffet cars.

Auxiliaries and Controls

ONE of the first things to strike an engineer when inspecting or handling diesel locomotives and railcars is the variety in the number and layout of the driving controls and auxiliary machines. A substantial variation is naturally to be expected with different transmission systems, but similar cars on similar duties frequently show a greater variety. Some railways seem to get along with driving and auxiliary controls and meters which can be counted on the fingers; on other units entrance to the cab can be gained only by pushing past levers, pumps, and valves, after which a vast array of gauges, meters and switches confronts one. We were privileged recently to inspect two up-to-date diesel vehicles, one of the simple school, the other of the complicated, and the differences in them were thereby brought home to us more strongly. In the cab of the first vehicle we counted 31 handles, switches, gauges, and meters, and there may have been more. In the cab of the second vehicle 14 details were sufficient to cover every major and minor operation. There is something to be said for giving an intelligent driver every opportunity for working his charge as efficiently as it will perform, but the efficiency should be overall rather than thermal, and we feel that the simpler and fewer the controls the better will the vehicle be found work when every aspect is taken into consideration, and the driver's attention will not be so liable to be distracted from the road, a point of some importance when the locomotive or railcar concerned is working in, or passing through, a densely-trafficked area.

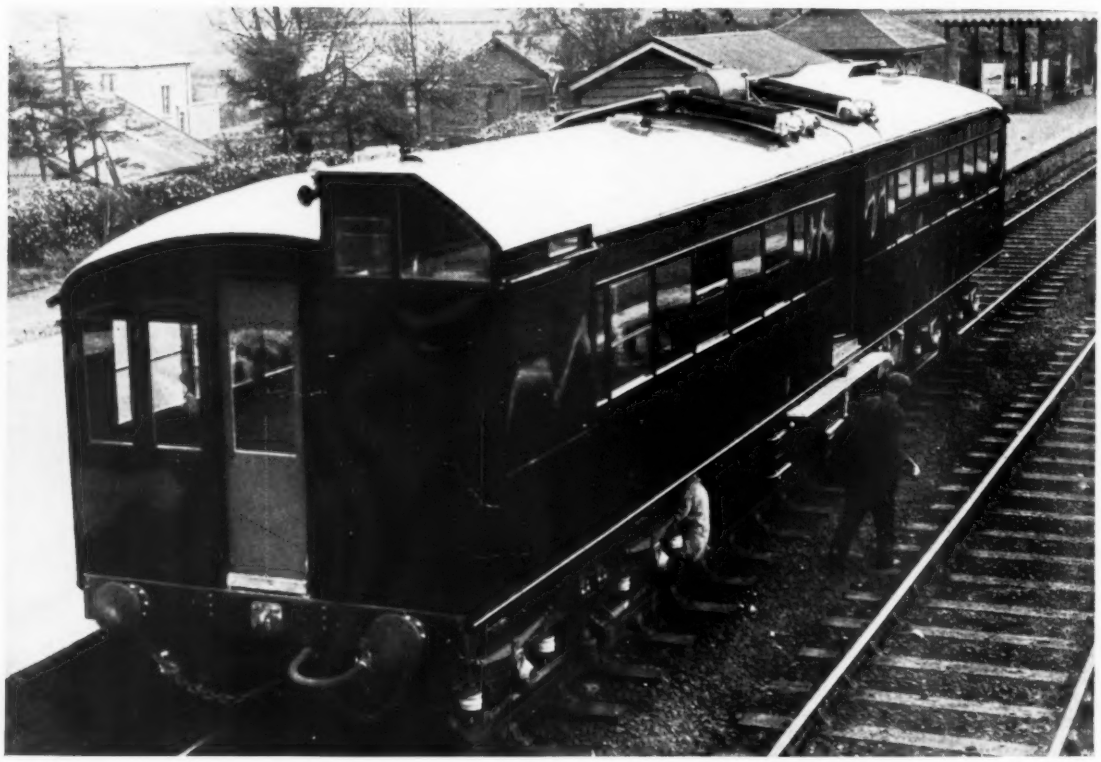
Light Metal in Car Construction

THE adoption of diesel traction has directed increased attention to one of the efficiency factors of modern railway operation, viz., the power-weight ratio of the tractor. The problem of reducing the unit weight may be, and has been, attacked in two ways. First, by increasing the engine power, since the weight of an engine goes up in a smaller ratio than the output; secondly, by reducing the weight of the vehicle for a given horse-power. In the latter connection the use of aluminium is coming rapidly to the fore, and it is only the present high price of this material and its alloys which prevents a much more extensive application, and an increased use will doubtless be found for plates, rolled sections, and castings.

Pure aluminium is rarely used in rolling stock work; alloying elements are necessary to give the requisite strength, hardness, and ductility, and alloys of silicon and magnesium-silicon are the most popular. Duralumin, the well-known aluminium-copper alloy with small percentages of manganese and magnesium, which is widely used in automobile and aircraft practice, has not yet been used to any great extent in coaching stock details. One of the earliest applications of aluminium alloys in the field now being considered was the production of carriage doors in Alpax, which is a silicon alloy containing approximately 87 per cent. of aluminium and 13 per cent. of silicon. But something more than the substitution of aluminium for odd fittings has been felt desirable in a number of recent diesel vehicles, including the 1,700 b.h.p. mobile power houses and locomotives built by Armstrong-Whitworth for the Buenos Ayres Great Southern Railway, and the Leyland-engined railcar for the Northern Counties Committee of the L.M.S.R., which is described in another part of this issue. In these cases the whole of the body and roof framing and panelling are constructed of aluminium alloy plates held together by rivets of similar composition, and although in the present state of the art, increased time is spent in forming and erecting the sheets and sections compared with steel construction, no trouble in service has been occasioned so far as we are aware, except in one case where the vehicles ran along a line close to the seashore for some miles on end.

DIESEL SUBURBAN SERVICE IN ULSTER

Powerful railcar now at work out of Belfast is to be provided with trailers to give a carrying capacity of 300



260 b.h.p. diesel railcar with Leyland engines, Northern Counties Committee, L.M.S.R.

AFTER using a double-engined petrol railcar with Leyland torque converters on local services out of Belfast for 18 months, the Northern Counties Committee of the L.M.S.R. have, under the direction of Major Malcolm Speir, the Manager and Secretary, inaugurated a supplementary service by means of a double-bogie diesel railcar with two engines totalling 260 b.h.p. At the present time the car is working alone, covering 195 miles a day from Monday to Friday and 105 miles on Saturday, but two trailers are now being built in the N.C.C. shops at Belfast, and when these are completed and in service the total seating capacity of the train will be 18 first class and 260 third class. The car itself seats 84 third-class passengers on a tare weight of 21·5 tons, and this gives a ratio of 12·1 b.h.p. per ton, or 9·6 b.h.p. per ton when fully laden. When the trailers are attached the tare weight of the train will be about 57 tons, giving a ratio of 4·6 b.h.p. per ton, or 3·45 b.h.p. per ton when fully laden. A characteristic of the stopping services on which it is employed between Belfast (York Road), Carrickfergus, and Kilroot is the short time allowed for the turn-round at the terminals, no longer than five minutes being the usual margin.

Power Unit and Transmission

Two 130 b.h.p. six-cylinder Leyland diesel engines form the power unit, and are of the same type as the engines fitted to the four-wheeled Leyland cars running on the English lines of the L.M.S.R. The cylinders have a diameter of 4·625 in. and a stroke of 6·0 in. and run normally at 2,000 r.p.m. To the flywheel casing of each engine is bolted the Leyland hydraulic torque converter, from which the drive is transmitted to the inner axle of each bogie through a tubular cardan shaft fitted with two Hardy-Spicer universal couplings. On each driving axle is mounted a double bevel reversing and driving gear with a ratio of 4·016 to 1. A maximum tractive effort of approximately 10,000 lb. can be exerted, and with the engine running at 2,000 r.p.m. the top speed is 53·5 m.p.h. During trials, the engine was run up to 2,350 r.p.m., giving a road speed of 62·8 m.p.h.

A subframe beneath the main underframe carries the engine-torque converter unit, and the rear support for the combination is under the flywheel casing. The two units are mounted end to end beneath the centre of the vehicle, and each has its own water cooling system, torque converter cooler, and starting battery. The last-named are of the Exide-Ironclad type of 24-volts 259 amp. hr. capacity, and in addition to providing the current for the starter, they supply power for the exhauster, and for the lighting and control systems. Charging of the batteries is carried out by Simms dynamos of 1·6 kW. capacity, which are driven by belts from the rear end of the torque converter. The C.A.V.-Bosch electric starting motor

operates on the flywheel, and the two-way starting switch is arranged so that only one engine can be started at a time. A hand crank arrangement, coming out at the side of the coach, is embodied for turning either engine over in the shops or during inspection.

Cooling of the engine circulating water is effected in gilled tube radiators mounted on the roof of the railcar, and the circuit is controlled by a Smith thermostatic switch. A cylindrical tank of 23 gal. capacity is mounted on the roof between the radiators. The torque converter liquid is cooled in two smooth tube coils fitted with thermostat switches and Bosch filters, and located beneath the underframe, but the lubricating oil is filtered and cooled in the engine sump. Electro-vacuum control of the torque converter, drive, and reverse is incorporated, but a simple lever arrangement is used for the engine throttle. A fuel tank of 75 gal. capacity is located beneath the underframe.

In each driving cabin is arranged a single heart-shaped dashboard with a very comprehensive range of controls. In the top centre is a large gauge for the vacuum brake, flanked on each side by revolution counters, one for each engine. In a row above these fittings are indicator lights for the converter fluid temperature, cooling water temperature, lubricating oil temperature, and for the glow plug operation of each engine, and a push-pull switch for the headlights. Close by are two push buttons for stopping the engines. Below the vacuum gauge are mounted on one panel the small hand levers for forward and reverse gear and torque converter or direct drive, the latter being used at various speeds according to the load and grade, but always at speeds above about 35 m.p.h. At the left-hand side of this panel is a two-way switch for the glow plugs of No. 1 and No. 2 engines, and in the same position on the opposite hand is a corresponding engine starting switch. Below these are ammeters for the charging current of each dynamo, and at the bottom are a push-pull switch for the C.A.V.-Bosch window wiper and a push button for the same firm's electric horn. Attached to a bracket projecting from the bottom of the dashboard is a hand lever for the engine throttle, and an improvement has been made in this detail by carrying it downwards instead of upwards as in the first Leyland vehicles. The driver's vacuum brake handle is on a separate column.

Bogies

The railcar bogies are not of the usual N.C.C. type, but are similar to the outside swing link pattern used for many years on the Great Western Railway. The frames and bolsters are of 9 in. by 3 in. Chromador steel channels; the end stretchers of the frame are welded to the longitudinals, but the centre transoms are secured by rivets and gussets. Disc wheels of 3 ft. diameter, made by Bessemer & Baker, are spread over a wheelbase of 9 ft., and are carried in Hoffmann roller bearings. Laminated bearing springs of flexible design are supplemented by Spencer Moulton auxiliary rubber springs, and the bolsters are supported on helical springs carried by four swing links with an outside rake of $1\frac{1}{2}$ in. Two brake blocks on each wheel are applied by the force from two 18 in. vacuum cylinders mounted on the car underframe, and transferred through rigging of the normal type. The vacuum is maintained by an electrically-driven Reavell exhauster having a capacity of 31 cu. ft. per min. against a vacuum of 20 in. when turning at 1,500 r.p.m. Teddington vacuum control switches automatically bring the exhauster into operation when the vacuum has fallen to 16 in., and cut it out when 20 in. has been reached.

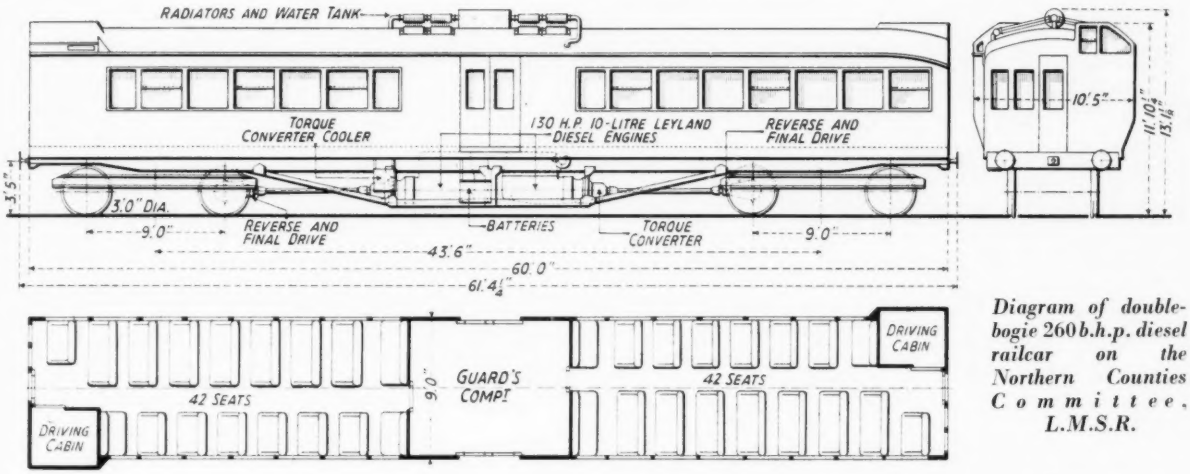


Diagram of double-bogie 260 b.h.p. diesel railcar on the Northern Counties Committee, L.M.S.R.

Underframes and Body

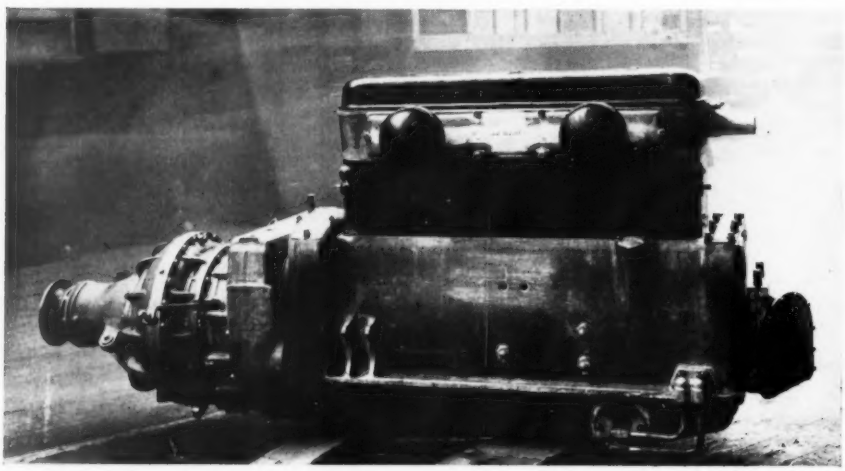
Light steel pressings are used for the underframe, which has a length over headstocks of 60 ft. The main longitudinal members are of channel section, having a maximum depth of 14 in. and a width of $3\frac{1}{2}$ in. The solebars are of 4 in. by 3 in. channel section pressings supported from the main members by riveted cantilever brackets. On the steel headstocks are mounted standard buffers and light drawgear of a type suitable for use with permanently coupled trailers.

The body is divided by a central luggage compartment into two main saloons, smoking and non-smoking. Entrance to the coach is through double Alpax doors sliding on Beclawat runners, which are also used for the wooden end and driver's compartment doors. The end doors are fitted to give the guard access to the trailers. As may be seen from the accompanying diagram, one of the most unusual features of the car is that the driving compartment at each end is in the form of a side conning tower projecting above the roof and beyond the side of the passenger compartment. This position was chosen because of the intention to operate the railcar between the two trailers and yet to keep all the driving gear in one vehicle. Access to the driving cabin is gained by four steps from the end of the passenger saloon.

Probably the most noteworthy feature of the whole car is the extensive use which has been made of aluminium.

The panels of the straight sides, the end plates and the roofs of the passenger compartments are all of aluminium plate, the two first-named being 18 w.g. thick and the last-named 20 w.g. Further, the side pillars, cantrails, and roof sticks are of aluminium alloy sections secured together by aluminium alloy rivets, and the material for luggage compartment, that is, the area in which the radiators are mounted, the roof of the diesel railcar is of wood.

Down each side of the centre gangway are arranged reversible double seats, of Laycock manufacture, which are upholstered in leather and have aluminium grab handles. Half the windows are of the drop type, and the others have fixed lights, but all have chromium-plated frames and were made by G. D. Peters & Co. Ltd. Light luggage racks are fitted down the sides above the seats, and are supported by aluminium frames cast by the N.C.C. at its York Road shops. The inside surface of all side and end panels is insulated with Thermotex board, the noise and heat resisting properties of which assist in ensuring the maximum comfort for the passengers. Two Airvac ventilators are located in the roof of each passenger compartment, and a small unit of the same type in each driving cabin. Lighting is effected by seven 15-watt Osram lamps in each compartment, these being arranged in staggered formation along the roof.



130 b.h.p. Leyland engine and torque converter, two of which are fitted to the Northern Counties Committee railcar

all these sheets and details was supplied by the Northern Aluminium Co. Ltd., who also bent the roof sheets and roof sticks. The framework sections, comprising the pillars, cantrails, and roof sticks are of 51SQA alloy, which has an ultimate strength of 19 tons per sq. in., a yield point of no less than 16 tons per sq. in., and an elongation of 14 per cent. on 2 in., in combination with a Brinell hardness number of 90. The outside panels are of 3S and 4S alloys, the former having an ultimate strength up to 12 tons per sq. in., and the latter up to 18¾ tons. The floorplate is also of 4S alloy, and the rivets securing the various members are of 17S alloy, which is practically the same as duralumin and has an ultimate strength of 11½ tons per sq. in when annealed, and as much as 27 tons when fully heat-treated and aged. A considerable saving in weight has been achieved by the use of this material and by the light underframe and bogie designs, as may be seen by comparing the tare weight of 21·5 tons with the 31 tons of the N.C.C. double-bogie petrol railcar, which is of normal carriage construction. Over the

In view of the intention, carried out, to place the railcar in regular service on June 1, the N.C.C. engineers decided not to fit heating apparatus at once, but to wait until the end of the summer and then withdraw the car from traffic for a few days in order to fit it up for winter conditions. As it is anticipated that the car will have covered by that time approximately 18,000 miles, it would in any case be coming out of service for a thorough inspection. Two Clarkson thimble-tube contra-flow exhaust heat boilers have already been ordered from the Clarkson Thimble Tube Boiler Co. Ltd., and will be installed in the luggage compartment. They will be worked in series, the cold water entering one boiler and, after being heated, pumped into the other, where steam will be generated. These boilers, in passing the exhaust gases of the two diesel engines, will also act as silencers; at the present time the cylinder contents are being exhausted through a pipe beneath the underframe. Circulation of the water will be effected by an electrically-driven pump, and the Westinghouse corridor heater will be fitted in the passenger saloons.

Northern Counties Committee 260 b.h.p. diesel-hydro-mechanical railcar outside the running sheds at York Road, Belfast

NEW DIESEL RAILCAR IN THE IRISH FREE STATE

Double-bogie design acquired by County Donegal Railways to supplement the services already worked by diesel traction

THE diesel railcar stock of the County Donegal Railways Joint Committee has just been added to by a further 74 b.h.p. vehicle with mechanical transmission, but, as recorded in the issue of this Supplement for December 1 last, this unit is of the double-bogie type, in contradistinction to the single axle plus driving bogie layout of the previous cars. Despite this, and an increase in passenger accommodation from 32 to 41, the tare weight is only 12 tons, or 657 lb. per seat. The car is now in operation on the Strabane-Letterkenny section, which has numerous sharp curves and a maximum grade of 1 in 40. Including the work done by the two original diesel cars between Strabane and Killybegs, and the petrol railcars on the Finn Valley line to Glenties, 70 per cent. of the train mileage of the County Donegal Railways is now operated by railcars, and part of the remainder is done by the diesel loco-tractor illustrated and described in the *Diesel Railway Traction Supplement* for December 1, 1933.

Above : General view of new railcar on the County Donegal Railways
Left : End view, showing engine casing and driving cabin

On the Letterkenny branch, the new railcar covers a daily mileage of 195, and maintains end-to-end timings of 55 to 79 min., depending upon the number and duration of the stops. The principal factor influencing the journey time is the length of the stop at Lifford Customs station, but stops to pick up or set down passengers are made at any point along the line. Starting at 7.50 a.m., from Strabane, the railcar makes five trips in each direction, finishing at Strabane at 9.30 p.m. Re-fuelling is done at Stranorlar, and every two or three days the car goes there from Strabane at night, returning in the morning in time to take up the working at 7.50 a.m.

As may be seen from the accompanying illustrations, the driving bogie of the car is at the front with the engine directly above it, and thus differs from the six-wheeled cars which have the driving bogie at the back. The wheels of the driving bogie are coupled, and give an adhesion weight of approximately 7½ tons with the car fully laden. The transmission comprises a friction clutch, four-speed gearbox and a worm drive and reversing gear on the axle, and with the Gardner six cylinder 74 b.h.p. diesel engine running at its normal speed of 1,300 r.p.m. gives speeds of 8·5, 13·5, 22·5, and 36·5 m.p.h. in the forward direction, and 6·5 m.p.h. in reverse. The complete power bogie and driving cabin was supplied by Walker Bros. (Wigan) Limited, and includes inside Timken roller bearing axleboxes.

Simple Control and Driving Gear

A fuel tank of 40 gal. capacity is fitted at the left-hand side of the driving cabin, and the fuel feeds by gravity to the engine. In front of the driver is a dashboard containing a vacuum gauge showing the pressure in the train pipe and in the vacuum chamber; a temperature indicator for the cooling water circuit, showing the correct range for normal working; a lubricating oil pressure gauge; an ammeter for the C.A.V.-Bosch coach lighting equipment, and an engine starting button. A panel on the side contains switches for the head and interior lights, and a push button for the hooter. The engine throttle and vacuum brake handle are both mounted on the same pillar in front of the driver, and the gear lever to the left. Foot control for the throttle is also provided, but the pressure required is rather strong for the foot to be kept on and the drivers prefer to use the hand lever. A clutch pedal is fitted in front of the gear lever, and a hand brake fitted to the back panel. As only a single driving position is provided, the car runs always in one direction, but as turntables are

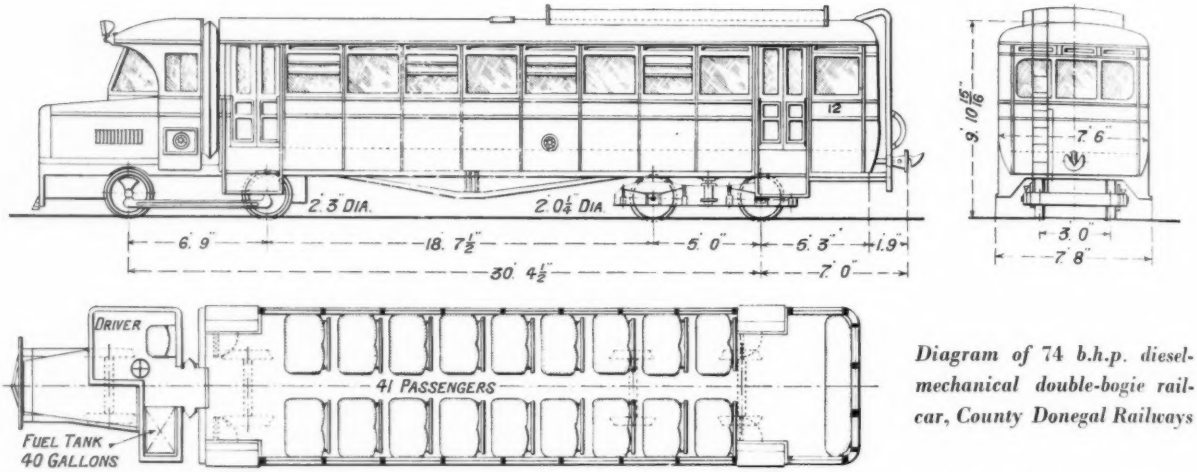


Diagram of 74 b.h.p. diesel-mechanical double-bogie railcar, County Donegal Railways

installed at both Strabane and Letterkenny, this occasions no inconvenience.

Body and Underframe of Irish Construction

The body and underframe of the passenger compartment and the rear carrying bogie were constructed at the Dundalk works of the Great Northern Railway of Ireland, under the direction of Mr. George B. Howden, the Chief Engineer of that railway. The side panelling is of steel, and the underframe is strengthened by side truss rods of the king-post type. Comfortable tubular-frame seats upholstered in moquette were supplied by G. D. Peters & Co. Ltd., and are arranged down each side. Entrance doors of the bus type are fitted at back and front on each side, and alternate windows are of Young's half-drop FU type, the remaining lights being fixed. Two Colt ventilators are fitted above the passenger compartment, and heating is effected by passing the engine cooling water through Burlingham heaters, the radiator on the front of the car being provided with adjustable shutters to prevent excessive cooling when the heaters are in operation.

Hoffmann roller bearings, of the type now regarded as standard for new stock on the County Donegal Railways, are fitted to the rear bogie, which is of an exceptionally well-sprung design. At the back of the vehicle a standard centre coupling, safety chains and vacuum brake hose are fitted, and this enables goods stock or a light passenger trailer to be coupled up when desired. Both vacuum and hand brakes apply blocks on all wheels; the former was intended for operation with a normal vacuum of 22 in., but during a recent visit to the County Donegal lines we noticed that the belt-driven exhauster was maintaining a vacuum of 24 to 24½ in. without fluctuation. The operation of the car is extremely simple when the driver knows the line; the time for a complete change from third to top gear we noted as 6 sec., and 7 to 9 sec. for lower changes, the tractive effort being nil for less than this period. Considering the light character of the permanent way the car runs very smoothly, and there is little swaying at the maximum speed. Over a full mile downhill we timed the car to maintain 32 m.p.h., and on another occasion the average speed over a quarter of a mile was 35 m.p.h. on a slightly falling grade.

Results with the Original Cars

Remarkably little trouble has been experienced with the two six-wheeled cars, the first of which was put into traffic in July, 1931, and the second in December of the same year. The first vehicle, No. 7 in the railway company's list, is at the moment undergoing overhaul at Stranorlar works. Up to the end of May it had covered 110,000 miles in "stop-anywhere" service on the Strabane-Killybegs line, which has heavy grades including a six-mile stretch at 1 in 50. Some time ago the engine was given a new set of piston rings, but apart from normal maintenance work and grinding in the valves, nothing was done to the engine until the beginning of the present month, when it was taken down for the cylinders to be rebored and the engine to be overhauled generally. For the time being, its place in service is being taken by the reconditioned petrol-railcar from the Dublin & Blessington Tramway, which in its rebuilt state was illustrated in THE RAILWAY GAZETTE of March 9, 1934. The second diesel car, No. 8, has now covered a mileage of over 107,000.

By the courtesy of Mr. Henry Forbes, the Secretary and Manager of the County Donegal Railways Joint Committee, we are enabled to publish a table showing the maintenance and renewal costs of the two six-wheeled cars since they went into service three and two and a-half years ago. The fuel consumption has averaged 16 to 17 m.p.g., or 0·30 to 0·33d. per mile, and the lubricating oil 300 m.p.g. Over the full 12 months of 1933 the operating

MAINTENANCE AND RENEWAL COSTS OF DIESEL RAILCARS, COUNTY DONEGAL RAILWAYS

	Railcar No. 7	Railcar No. 8	Total of Railcars Nos. 7 and 8
Date put into traffic	July, 1931	December, 1931	
	£	£	£
Actual cost of all materials supplied for maintenance and renewal, from date put into traffic to 31.3.1934 ..	160	117	277
Wages paid to shopmen for maintenance and renewal from date put into traffic to 31.3.1934	102	76	178
Allowance of 20 per cent. to above wages for supervision	21	15	36
Total cost for maintenance and renewal to 31.3.1934	283	208	491
Miles run by cars from date put into traffic to 31.3.1934	101,391	96,802	198,193
Cost for maintenance and renewal per mile run from date put into traffic to 31.3.1934	0·67d.	0·52d.	0·59d.

TIMETABLE OF LETTERKENNY BRANCH, COUNTY DONEGAL RAILWAYS

Down Trains—Week Days

Miles from Strabane	Stations	S. Mails only	M.	M.	S.	M.	T. Goods only	M.	S.	S.	M. Mails only	M.
		a.m.	a.m.	a.m.	a.m.	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.
	STRABANE .. dep.	7 20	*7 50*	*10 50*	11 45	*1 25*	2 36	*4 30*	4 55	—	6 36	*7 25*
1	Lifford Halt .. arr.	7 22	*7 52*	*10 52*	11 47	*1 27*	2 38	*4 32*	4 57	—	6 38	*7 27*
	Lifford Halt .. dep.		*8 0*	*10 55*	12 5	*1 30*		*4 35*	5 0	—		*7 30*
2¾	Ballindrait .. ,,		*	*	*	*		*	*	6 0		*
4¾	Coolaghy Halt .. ,,		*	*	*	*		*	*	*		*
6½	RAPHOE .. ,,		*8 20*	*11 12*	12 27	*1 50*		*4 55*	5 30	6 50		*7 50*
9	Convoy .. .. ,,		*8 28*	*11 20*	12 35	*1 57*		*5 3*		7 0		*7 58*
11	Cornagillagh Halt ,,		*	*	*	*		*		*		*
13¾	Glenmaquin .. ,,		*	*	*	*		*		*		*
19¼	LETTERKENNY arr.		*8 55*	*11 45*	1 4	*2 22*		*5 30*		7 30		*8 25*

Up Trains—Week Days

Miles from Strabane	Stations	S. Mails only	M.	M.	S.	T. Goods only	S.	M.	S.	M. Mails only	M.	M.
		a.m.	a.m.	a.m.	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.
19¼	LETTERKENNY dep.		*9 30*	*11 50*	1 5		2 25	*3 5*			*6 15*	*8 30*
13¾	Glenmaquin .. ,,		*	*	*		*	*			*	*
11	Cornagillagh Halt ,,		*	*	*		*	*			*	*
9	Convoy .. .. ,,		*10 0*	*12 18*	1 40		2 55	*3 35*			*6 40*	*
6½	RAPHOE .. ,,		*10 10*	*12 28*	1 50		3 5	*3 43*	5 35		*6 48*	*
4¾	Coolaghy Halt .. ,,		*	*	*		*	*	*		*	*
2¾	Ballindrait .. ,,		*	*	*		*	*	5 50		*	*
1	Lifford Halt .. ,,	7 28	*10 28*	*12 43*	2 13	2 53	3 28	*4 3*		6 40	*7 8*	*9 28*
	STRABANE .. arr.	7 30	*10 30*	*12 45*	2 15	2 55	3 30	*4 5*		6 42	*7 10*	*9 30*

Services shown in italics are operated by new diesel railcar. M.—Railcar. S.—Steam train. T.—Diesel loco-tractor. * Trains will pick up or set down passengers if required.

costs of the two diesel cars amounted to 1·60d. per mile, made up as follows:—

Wages	1·08d.
Fuel	0·30d.
Lubrication and sundries ..	0·22d.
Total	1·60d.

If to this total is added the maintenance cost of 0·59d. per mile from the appended table, and an allowance for depreciation and interest of 1·2d. per mile, the gross operating cost per mile comes to 3·39d. This excludes the general overhaul now being given to one car, but even taking the cost of this without adding to the mileage already covered, the gross cost would not exceed 4d. per mile, whereas the cost of the steam trains on the same line is 10·5d. per mile exclusive of interest and depreciation. This in itself is a low figure, and a good deal below representative figures for standard gauge railways, but the economy effected by the new diesel railcar amounts to something like £750 a year.

Interior of new double-bogie single-class railcar as used for rural and light cross-country services on the County Donegal Railways

NOTES

Black Forest Railcar Service.—It is reported that by the end of the present year six diesel-electric railcars will be in operation on the Hollental line in the Black Forest. Some time ago it was stated that the Reichsbahn authorities intended to electrify this line, but the proposal has apparently been shelved.

Future of Diesel Traction in Austria.—Despite various reports to the contrary, the Austrian Federal Railways do not intend to order further diesel units in any considerable number during the current year. A thorough trial is to be given to the latest 160 b.h.p. railcars and 300-b.h.p. locomotives, both of which were described in the issue of the *Diesel Railway Traction Supplement* for October 6, 1933.

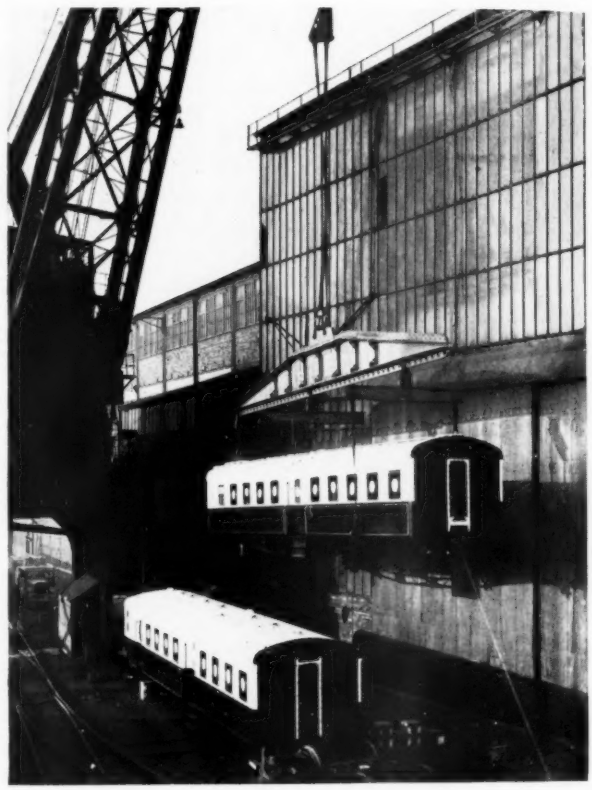
Recent Sulzer Orders.—A new range of diesel engines suitable for railcars has been evolved by Sulzer Bros., of Winterthur, the principal characteristics of which are somewhat lighter weight and higher rotational speed than has hitherto been adopted by this firm. Welding has been extensively used in the fabrication of the engine. Orders have already been obtained from the South Manchuria Railway and the Swiss Federal Railways, both of which lines have used the older type of Sulzer engine for some years.

Flying Hamburger Mileage.—During the seven months of 1933 and January of the present year the Flying Hamburger covered a distance of 111,600 km. in revenue service, made up as given in the following table :—

1933 June	9,558 km.	1933 October ..	14,550 km.
July ..	13,122 ,,	November ..	15,560 ,,
August ..	14,974 ,,	December ..	13,448 ,,
September	15,500 ,,	1934 January ..	14,888 ,,

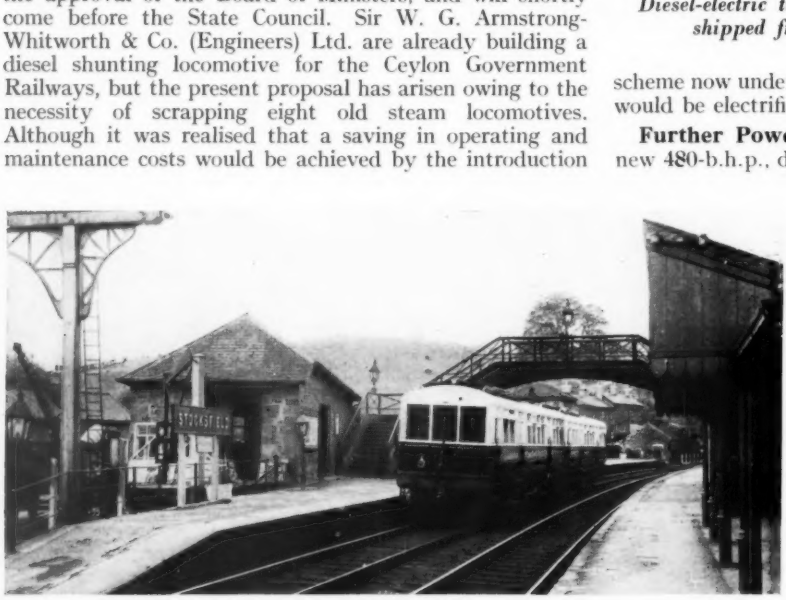
This represents an availability of 89 per cent. at an average journey speed of 77·4 m.p.h. in one direction and 76·3 m.p.h. in the other. The number of passengers carried by the car per trip has averaged from 55 to 60. Further cars of similar design are now under construction.

Diesel Traction in Ceylon.—It is understood that a proposal to replace steam trains on certain sections of the Ceylon Government Railways by diesel units has received the approval of the Board of Ministers, and will shortly come before the State Council. Sir W. G. Armstrong-Whitworth & Co. (Engineers) Ltd. are already building a diesel shunting locomotive for the Ceylon Government Railways, but the present proposal has arisen owing to the necessity of scrapping eight old steam locomotives. Although it was realised that a saving in operating and maintenance costs would be achieved by the introduction of diesel traction, the proposal has been opposed by certain members of the Executive Committee of Communications and Works on the ground that once the hydro-electric scheme now under construction was completed the railways would be electrified.



Diesel-electric trains for the San Paulo Railway being shipped from Armstrong Whitworth's works

Further Powerful Diesel Cars for Denmark.—Ten new 480-b.h.p., double-bogie diesel-electric railcars are to be ordered from the well-known locomotive building firm of A/S Frichs by the Danish State Railways for use on the line from Copenhagen to Hillerod ; the Copenhagen-Holte section is now being electrified. These cars are to be duplicates of the 10 express cars of the same power set to work during the last five months, except that, in order to provide a more rapid acceleration and keep the inner suburban lines clear for following electric trains, the motors and gears have been altered to give an increase in tractive effort of 50 per cent. over the express railcars with a decrease in maximum speed from 75 to 50 m.p.h. The new railcars are to be used in conjunction with three trailers, the whole train having a seating capacity of about 300. A speed of 84 m.p.h.

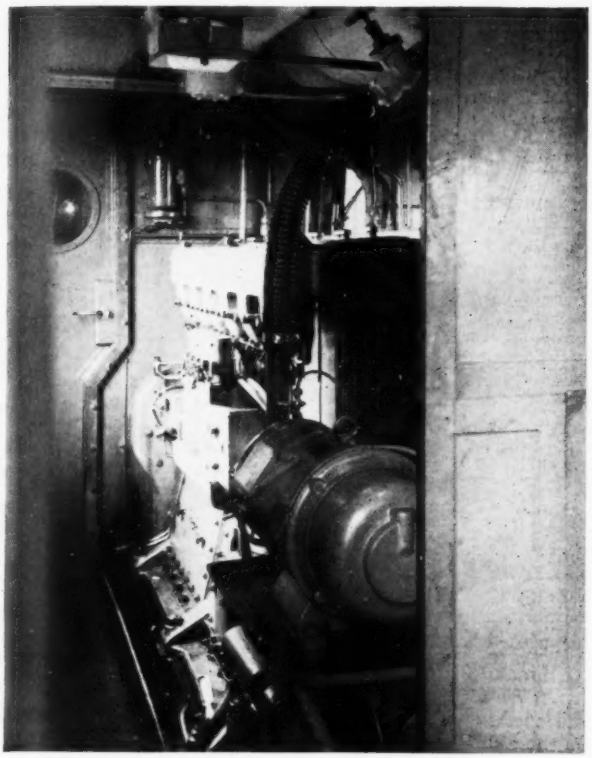


The two Armstrong-Whitworth railcars just purchased by the L.N.E.R.

NEWS

has already been reached with one of the 10 cars which have recently gone into service.

Brazilian Diesel Trains.—It is reported that, on trials, the diesel-electric train supplied by Armstrong-Whitworth to the San Paulo Railway at the beginning of the present year, and described in the *Diesel Railway Traction Supplement* for December 1, 1933, reached a speed of 64½ m.p.h. The Brazilian Government has given permission for this train to be regularly worked up to a maximum speed of 56 m.p.h., although a limit of 50 m.p.h. is common in Brazil, but it is the intention of the San Paulo Railway to approach the Government with a view to the maximum being raised to 68 m.p.h. On this assumption, a considerable reduction in the time for the 49-mile journey from San Paulo to Santos—including the 7½-mile Sierra section—should be possible, and it is anticipated that a time of 80-85 min. will be possible against the present best of 107 min. by steam trains. Only the compulsory stops at the top and bottom of the Sierra will be made on this timing. One of the cars in this train is at present being fitted up with Pullman accommodation, and it is hoped that by the time this alteration is finished it will be possible to run to the accelerated schedules with a maximum speed of 68 m.p.h.



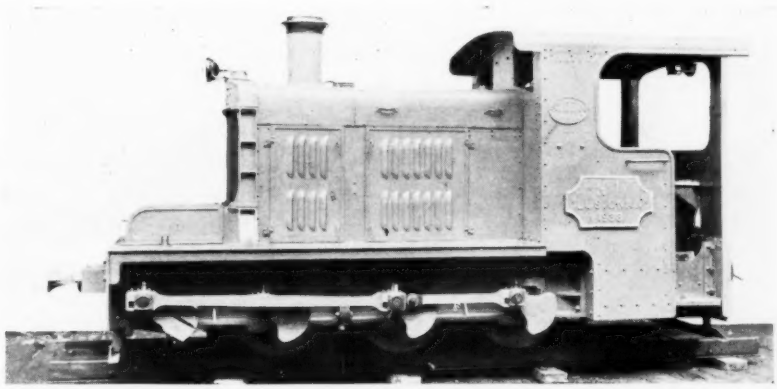
The engine room of the new Frichs' 480 b.h.p. railcars on the Danish State Railways

L.N.E.R. Diesel Railcar Service.—The two 250 b.h.p. Armstrong-Whitworth diesel-electric railcars purchased recently by the L.N.E.R. are now providing supplementary services in Yorkshire. The first, *Lady Hamilton* by name, is at work between Leeds and York, via Church Fenton and via Harrogate, on express service, and stopping trips are also made to Church Fenton and Horsforth. The non-stop direct runs between York and Leeds are covered in the standard steam-hauled express timing of 30 minutes for the 25½ miles. The second vehicle, the *Northumbrian*, is working between Hull, Selby and Pontefract, and Hull and York.

American High-Speed Diesel Locomotive.—A streamlined diesel-electric locomotive of 1,800 h.p. is to be built for operating a high-speed passenger service between Washington and Jersey City, on the Baltimore & Ohio Railway. The train will consist of six carriages, and a similar train will also be hauled by a 4-4-4 steam locomotive with 7-ft. driving wheels. The sum of $900,000 has been allotted to the B. & O. by the Public Works Administration for the building of these trains, and in order to test out different systems of construction, half the carriages will be of aluminium alloy and half of corrosion-resisting high-tensile steel.

A World's Record Run.—It has been reported in *The Times* that in its journey to the Chicago World Fair, where it is to be exhibited during the summer, the diesel-electric train, the "Burlington Zephyr," ran from Denver to Halsted station, in Chicago, a distance of 1,015 miles, without a stop. The time was checked to 13 hr. 5 min. 44 sec., giving an average speed of 77·6 m.p.h., and it is claimed that a maximum rate of 112·5 m.p.h. was maintained for three miles. Over the 401 miles separating Denver and Harvard, Nebraska, the speed was 79·1 m.p.h. The "Burlington Zephyr" was described in the *Diesel Railway Traction Supplement* for May 18.

Russian Diesel Traction Activities.—One of the first large diesel-electric locomotives built throughout in Soviet factories recently made a trial trip between Moscow and Leningrad before going into regular service between Aksabad and Kislovodsk to the east of the Caspian Sea. This locomotive is one of the ten 2-Eo-1 goods locomotives with 1,200 b.h.p. engines built by the Kolomna works under licence from M.A.N., and a further 20 are to be put in hand this year. It is also understood that the Kolomna works are designing a 2,700 b.h.p. fast diesel locomotive.

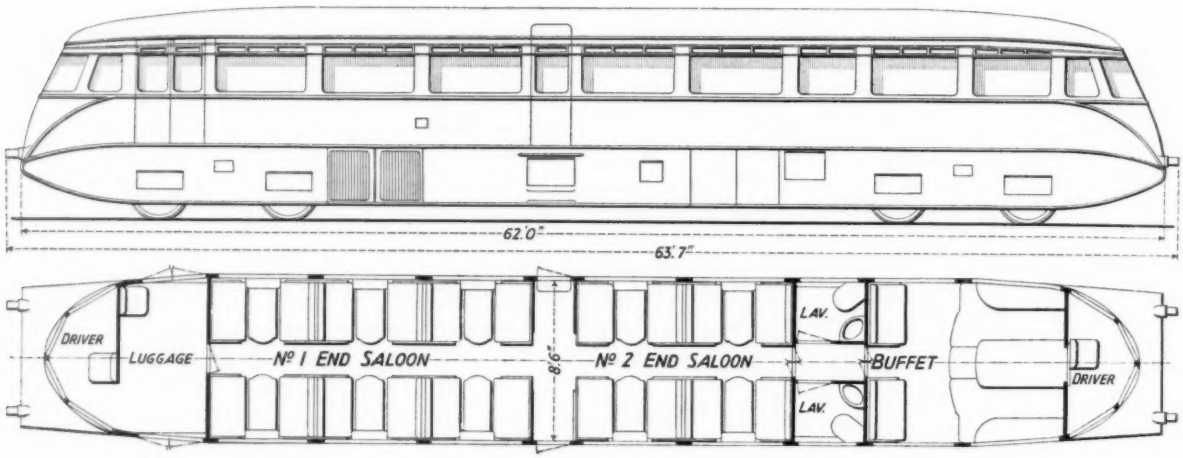


45 *b.h.p. Fowler diesel-mechanical locomotive for British Guiana*

FAST CROSS-COUNTRY SERVICES BY RAILCAR

Express diesel railcars with buffets are to operate on the G.W.R. between South Wales and the Midlands

WITH the inauguration of the summer timetables on July 9, the Great Western Railway will begin a service of express diesel railcars, specially suited to the needs of business men, between Birmingham and Cardiff. This is the first time a regular diesel working has been run on a fast schedule in Britain, and the service will be maintained by two diesel-mechanical cars, with a third in reserve, which are now almost complete. Three further cars will follow later in the summer. The basis of the design of these new vehicles is the 130 b.h.p. A.E.C.-engined railcar now working between Slough, Reading, Didcot, and Oxford, and which since the beginning of February has covered a mileage of 23,000, running 240 miles a day, with 75 stops, for six days a week, and at an average start to stop speed of 35·3 m.p.h. over a mean distance between stops of 3·2 miles. This vehicle was fully described in the *Diesel Railway Traction Supplement* for July 14 and November 3, 1933.



Layout of new 260 b.h.p. A.E.C. diesel-mechanical railcar for the Great Western Railway

The new cars have been designed and constructed by the Associated Equipment Company, of Southall, under the direction of Mr. C. F. Cleaver, to the requirements of Mr. C. B. Collett, the Chief Mechanical Engineer of the Great Western Railway. The main point of difference compared with the original A.E.C. railcar is that, as the maximum designed speed is 75 to 80 m.p.h. in place of 60 m.p.h., two engines have been incorporated in place of one, but in order to reduce the cost and weight and at the same time obtain simplicity, only one engine is fitted with a gearbox, the other driving directly.

Streamlining to the contour of the present car has been adopted to reduce the power required at high speeds. Each engine and transmission unit is mounted outside the underframe down one side of the car, in the manner used in the A.E.C. Q-type bus, and both can be readily inspected by removing the lower panels on the sides of the body; but in order that no floor space may be taken up by an engine room, the complete power equipment is arranged below floor level, and apart from the driving compartments at each end, the whole length of the car is available for passengers or luggage.

The A.E.C. four-stroke light-weight oil engine is of the type used in London buses. It has six cylinders 115 mm. by 142 mm., and develops 130 b.h.p. at 2,000 r.p.m. The maximum rotational speed of the engine is 2,250 r.p.m., and at this rate the four gears give respectively rail speeds of 18, 32, 50, and 75 m.p.h., the gear ratio on the axle being 3·12 to 1. The engine circulating water is cooled in two gilled tube radiators situated beneath the underframe, and which are cooled themselves by the natural draught of motion directed on to them by hinged baffles which swing over when the direction of motion is changed.

From the crankshaft the torque is transmitted on one side through a special type of fluid flywheel and a four-speed pre-selective epicyclic Wilson gearbox to a long cardan shaft with two universal couplings, by means of which the drive is taken to the inner axle of the bogie, and thence by a similar shaft to the second axle. The worm drive on the axles is housed in the Timken main roller bearing castings. On the other side of the vehicle the drive goes straight through from the fluid coupling to the cardan shaft and drives only one axle, as it does not possess the high torque of the geared engine. Only 75 per cent. of the car weight is thus available for adhesion. As the combination of geared and direct drive means two engine speeds, a cam-operated attachment on the change-speed gear is fitted to compensate for this, and allows only a restricted throttle opening on the direct drive engine until the geared unit is in top gear and the two speeds are the same. The direct drive engine has no idling speed, and stops when the fuel regulator is moved back.

The bogies are of the swing link type with disc wheels, 3 ft. 1 in. in diameter, spread over a base of 7 ft. The brake drums are mounted inside the wheels, and are built up in halves bolted into a register in the wheel in such a way that they may be removed for examination or

renewal without the wheels having to be taken off the axles or out of the bogie. The Ferodo-lined brake shoes are cam-operated and expand inside the drum; they are mounted on carriers fitted with roller bearings running on the axle, and they may be slid out of the drums for inspection or relining. The brake shoes are actuated by vacuum hydraulic mechanism, and to provide the vacuum for this purpose and for the sanding gear, a small exhauster is attached to each power unit, and another to one of the reverse gear boxes, the latter acting in the manner of a small ejector on a steam engine, and maintaining the vacuum while the car is coasting.

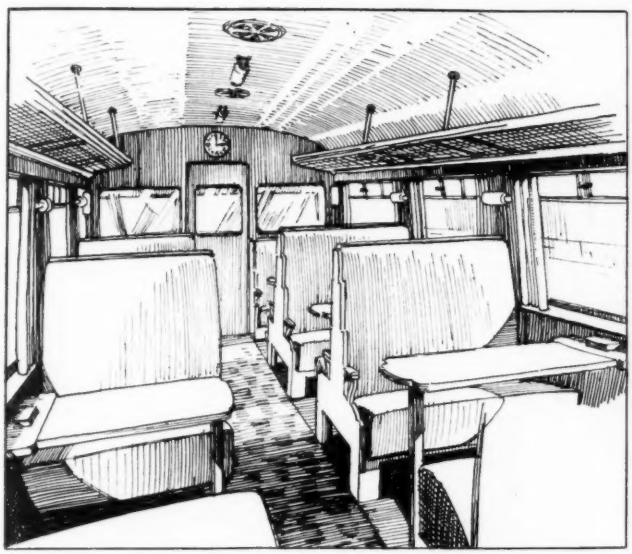
The control is similar to that used on the first car, and all the fittings are duplicated so that the car may be driven at the same speeds from either end; they are connected by steel rods or ribbons beneath the floor. Centrally in front of the driver is the lever for pre-selecting the gear; to the left is the clutch pedal and to the right the accelerator pedal. The hand brake and reversing levers are on the right, and to the left is a small column carrying the sanding and vacuum brake levers and the electric horn button. In front is a dashboard carrying all the usual gauges, meters, starting buttons and light switches. Beneath the driving seat is located the automatic train control equipment which is connected electrically to a shoe carried on one of the bogies. When the car passes a distant signal at clear a bell is rung in the driving cabin, but if passed at danger, a small whistle is blown and the brakes applied.

Two fuel tanks of 45 gal. capacity are secured to the underframe, and hold sufficient fuel for a run of 450 to 500 miles. Two separate lighting circuits are installed, a dynamo being mounted on each engine with an independent battery, so that if either system should fail, half the lights in the car would still be available.

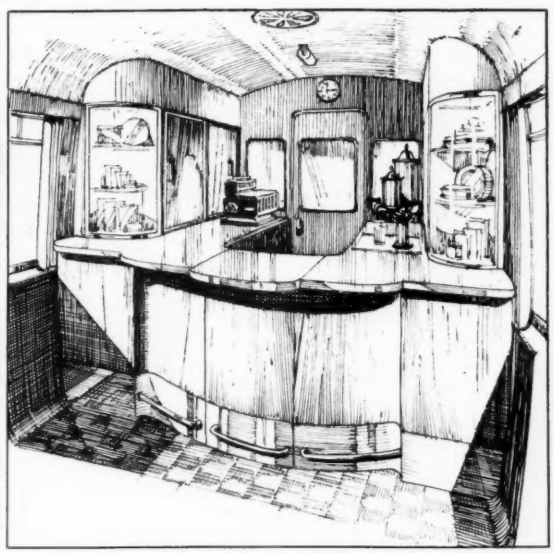
The car bodies are being built by Park Royal Coachworks Limited, and the interior decoration is being carried out by Heal & Son, of London. As may be seen from the accompanying diagram, a buffet is fitted up at one end of the car, and access to it is gained from the passenger compartment by a glazed door. The counter and shelves are of weathered oak with chromium-plated fittings. It is provided with a toast rack and coffee boiler and equipment for preparing light meals. Three gas cylinders are fitted beneath the underframe for supplying the cooking apparatus.

Third class accommodation only is provided, but it is of a superior type, and as the tickets issued will be limited to the seating capacity of the car, every passenger will be sure of a seat. The passenger saloons are fitted with fixed seats with removable tables between and the seats and tables are in weathered oak. The former are upholstered with green horsehair, and the panels and pelmets are of light oak covered in gold-brown Rexine. Tubular lights with two bulbs are fitted on the side panels above each seat, and the same type of lamp is also fitted down the centre of the roof, where it is interspersed with ventilators. Sliding ventilators are placed above the windows.

Entrance to the car is in the middle through double doors opening into a vestibule which leads to the two long centre-gangway saloons. Steps have been built in below the floor of the car, and are without any outward projection which might increase the air resistance. Hot water for the lavatories is obtained by surrounding the silencer with a water jacket as it passes up from the underframe to the roof, above which the exhaust gases of the engine are ejected.



Interior of the passenger saloon in the new Great Western railcars



Interior of the buffet, showing glazed door with driving compartment

From Monday to Friday, one return trip a day will be made in each direction between Birmingham and Cardiff, so that each car will cover a daily mileage of 234. The timetables and distances are as follow:—

Miles.			a.m	p.m.
—	Birmingham (Snow Hill) ..	dep.	9·05	3·40
60¾	Gloucester	arr.	10·17	4·52
		dep.	10·19	4·54
105	Newport	arr.	11·10	5·52
116¾	Cardiff	arr.	11·27	6·10
Miles.			a.m.	p.m.
—	Cardiff	dep.	9·10	4·50
11¾	Newport	dep.	9·29	5·06
56	Gloucester	arr.	10·21	5·55
		dep.	10·23	5·56
116¾	Birmingham (Snow Hill) ..	arr.	11·35	7·15

Local passengers will not be conveyed between Cardiff and Newport, or *vice versa*, and a supplementary fee of 2s. 6d. will be charged in addition to the ordinary third class fare, which will cover the full journey from Cardiff to Birmingham.

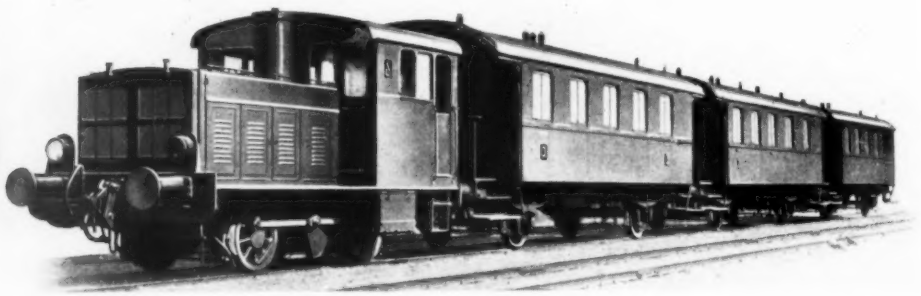
LIGHT PASSENGER LOCOMOTIVES

Four-wheeled gear-drive German machine for standard gauge

DEVELOPED from the design of the 33 diesel-mechanical shunting locomotives supplied last year to the Soviet Government, a new type of small locomotive has been brought out by the Deutsche Werke Kiel A.G., and the first unit constructed is now at work in light passenger traffic on the lines of the Kiel-Segeberger Light Railway.

Powered by a four-cylinder four-stroke Deutsche Werke oil engine developing 150 b.h.p. at 1,000 r.p.m., the locomotive is fitted with a four-speed gearbox, the final shaft forming a jackshaft between the wheels whence the drive is taken to the road wheel crank pins. The four gear steps give respective speeds of 4·65, 8·7, 18·0, and 28·0 m.p.h., with corresponding drawbar tractive efforts of 9,200, 4,870, 2,195, and 1,310 lb. Gear changing is carried out pneumatically, each gear having a clutch of its own. An electric starter is provided for the engine, and a 24-volt battery is fitted to supply the necessary current for the starting and for the head and cab lights.

The locomotive scales 26 tons in working order, and in addition to being retarded by a hand brake is normally fitted with an air system. In the locomotive illustrated, however, a vacuum brake also is fitted, as this system is used on the stock of the Kiel-Segeberger Railway. Hand sanding gear is fitted to the outside of each set of wheels, and standard buffing and drawgear is mounted on the steel plate buffer beams. The controls in the cab are few and simple, and consist of a reversing lever, throttle lever, gear changing lever, and brake handle, all of which are short horizontal levers mounted on a control desk. The gear and reversing controls are quite small, as the operations are carried out by compressed air and only a small force is needed on the handles. On a small dashboard in front of the control desk are mounted ammeters and voltmeters for the electric starting and lighting equipment, and an engine starter button. From the back panel of the desk projects the sanding handle.



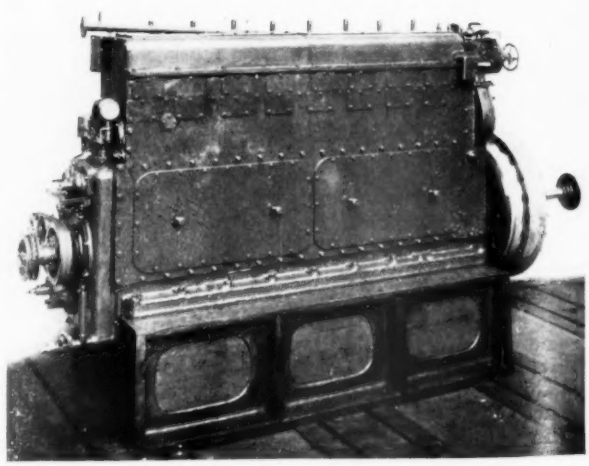
150 b.h.p. diesel-mechanical locomotive hauling local train on the Kiel - Segeberger Light Railway

A NEW RAILWAY OIL ENGINE

British design combines simplicity and substantial weight with high speed and small bulk

THE possibilities of a conservatively-rated engine, the bulk of which would allow it to be installed in a confined space if necessary, were realised some time ago by the firm of W. H. Allen, Sons & Co. Ltd., of Bedford, whose latest production forms the power unit in the diesel-mechanical locomotive (described in our last issue) recently supplied by the Drewry Car Co. Ltd. to the L.M.S.R. Within overall dimensions of 7 ft. 6 in. long, 2 ft. 6 in. wide exclusive of flywheel, and 4 ft. 0 in. high, and a net weight of 5,710 lb., has been constructed an engine capable of giving a continuous output of 160 b.h.p., and of carrying an overload of 10 per cent. for two hours. The unit weight of 35·7 lb. per b.h.p., although above the average of traction-type oil engines, is by no means incompatible with an efficient and economical shunting locomotive design. An interesting feature of the engine is that it runs at a speed of 1,200 r.p.m., or about twice the revolutions of other makes of similar unit weight, while retaining a low brake m.e.p.

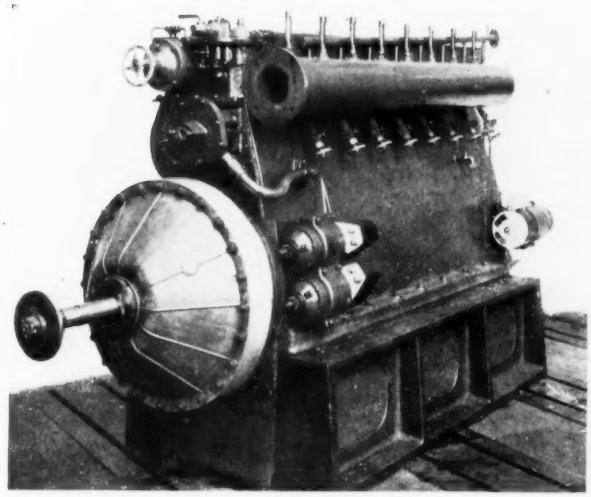
Fuel is injected directly into the eight 5·73 in. by 7·1 in. cylinders at a pressure of 3,000-3,500 lb. per sq. in., through the medium of eight C.A.V.-Bosch pumps with automatic differential pistons, which are entirely separate from each other, and are mounted in close proximity to the corresponding fuel injector. The working cycle characteristics of the engine are what might be expected from a four-stroke unit running at 1,200 r.p.m., *i.e.*, the indicator cards show an approximation to the constant-volume cycle, the maximum cylinder pressure being in



Latest type of 160 b.h.p. airless-injection eight-cylinder Allen railway oil engine

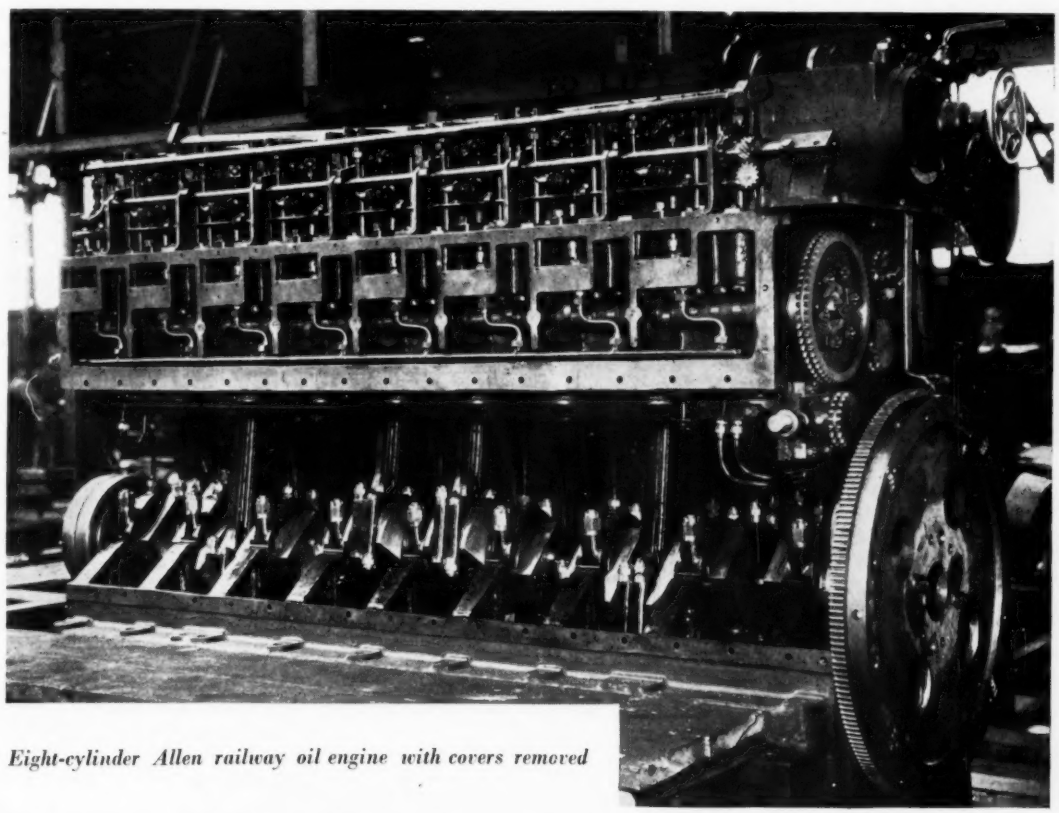
the neighbourhood of 700 lb. per sq. in. with a compression pressure of 500 lb. per sq. in. The fuel pumps are driven by cams mounted on the inlet and exhaust valve camshaft, which is driven from the main camshaft by a Renold duplex chain. Each cylinder has two inlet and two exhaust valves; both of the former are driven through one rocker from a single cam, but the exhaust valves each have a cam of their own, this arrangement giving four cams per cylinder. The nominal fuel consumptions are 0·412 lb. per b.h.p. hr. at full load, 0·421 lb. at three-quarter load, and 0·45 lb. at half load. At full load the lubricating oil consumption is guaranteed by the makers as 0·0085 lb. per b.h.p. hr. The centrifugal governor regulates automatically the fuel supply at all loads, and permits the engine speed to be varied while running.

A one-piece crankcase and cylinder block of cast iron forms the main constituent of the engine, and by the adoption of conveniently placed covers for gaining access to the crankshaft and camshaft, the headroom required above the engine for overhaul purposes has been reduced to a minimum. Independent cast iron cylinder heads are used, and the pistons of the same material run in centrifugally-cast nitrogen-hardened cast iron liners. The nickel-steel crankshaft is of ample proportions, and although it is not hollow-bored or counterbalanced, the running of the engine appears to be quite smooth, and the vibration damper fitted is effective in counteracting the vibrations of the critical speeds, which, we understand, occur only in the neighbourhood of 200 and 720 r.p.m. Big-end bearings formed of white-metal run directly on to the drop-forged steel connecting rod are used, and as may be seen from the illustration of an opened-up engine which accompanies this article, the big ends are of the four-bolt type, the bolts on each side running in opposite directions.

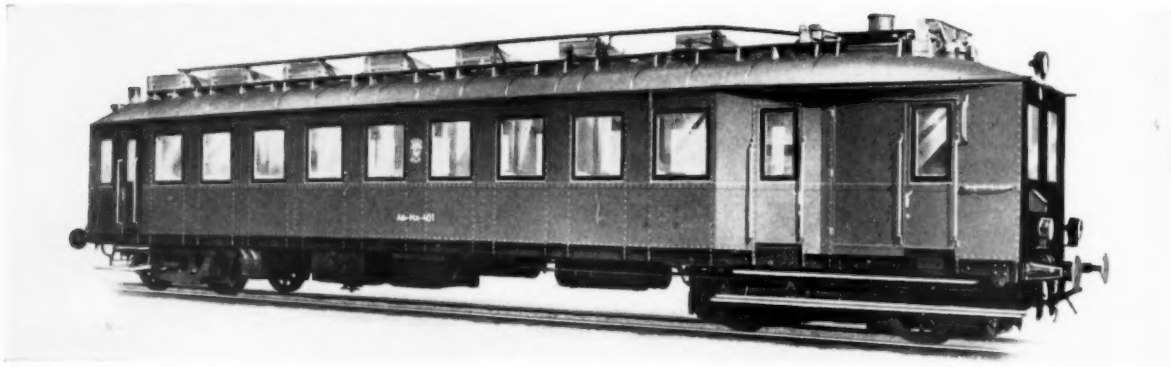


160 b.h.p. oil engine with Vulcan-Sinclair hydraulic coupling attached

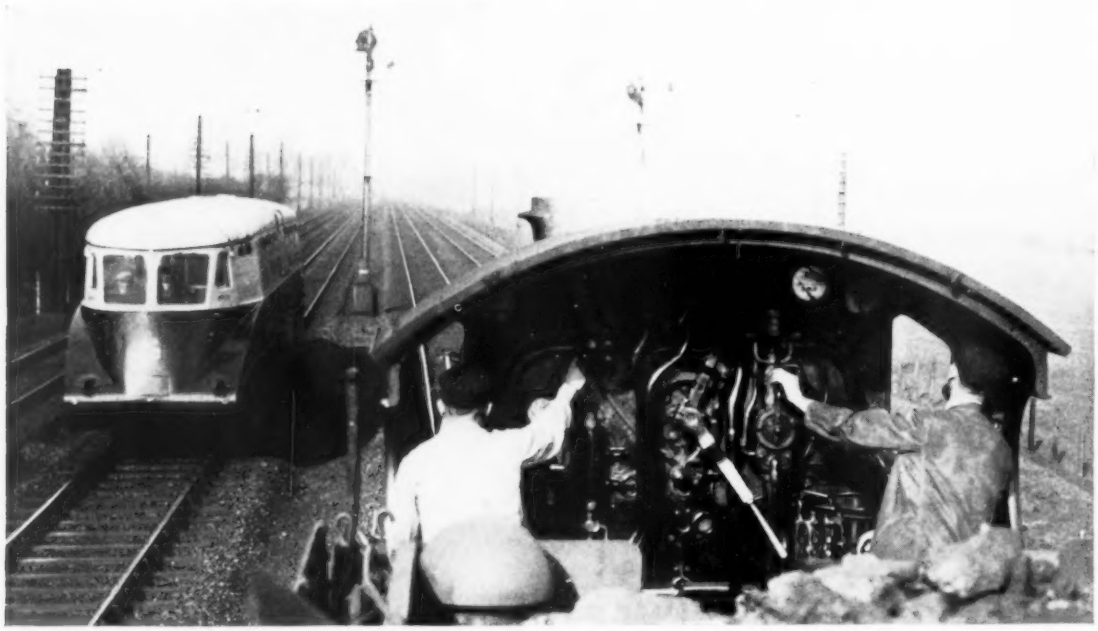
An entirely automatic lubrication system, supplied at a pressure of 15-25 lb. per sq. in. by a gear-driven pump, delivers oil to all the working parts. The oil is passed through a filter after leaving the sump, and the system can be primed by hand after periods of idleness. In the L.M.S.R. locomotive a Vulcan-Sinclair hydraulic coupling is fitted on the end of the crankshaft, and has proved very effective in safeguarding the engine from stalling or overload. In the same locomotive the engine circulating water and lubricating oil are cooled in a Serck sectional radiator, and the engine is started electrically.



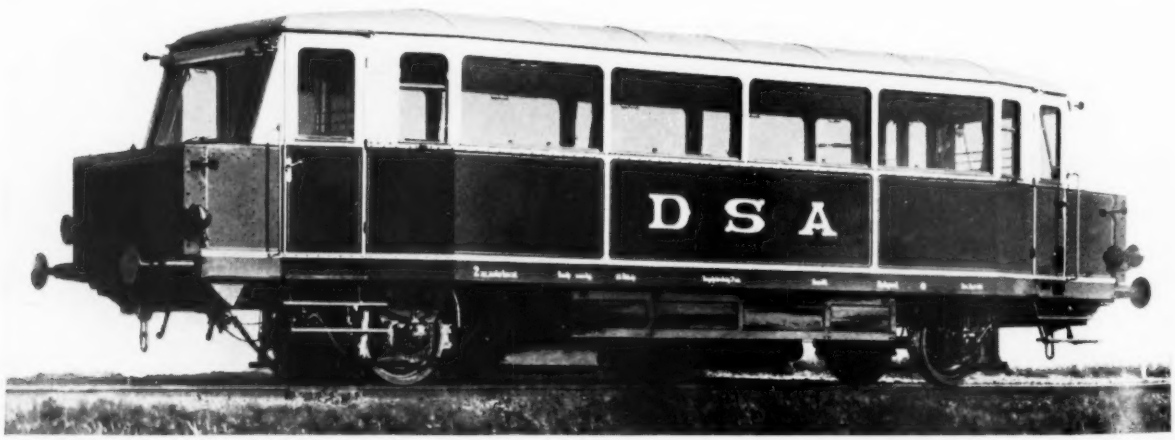
Eight-cylinder Allen railway oil engine with covers removed



A 150 b.h.p. diesel-mechanical railcar now running on the railways of the U.S.S.R.



A view of the A.E.C. 130 b.h.p. diesel railcar taken from the tender of a G.W.R. express. Six double-engined cars of enlarged design are now being built for the Great Western and are described in this issue

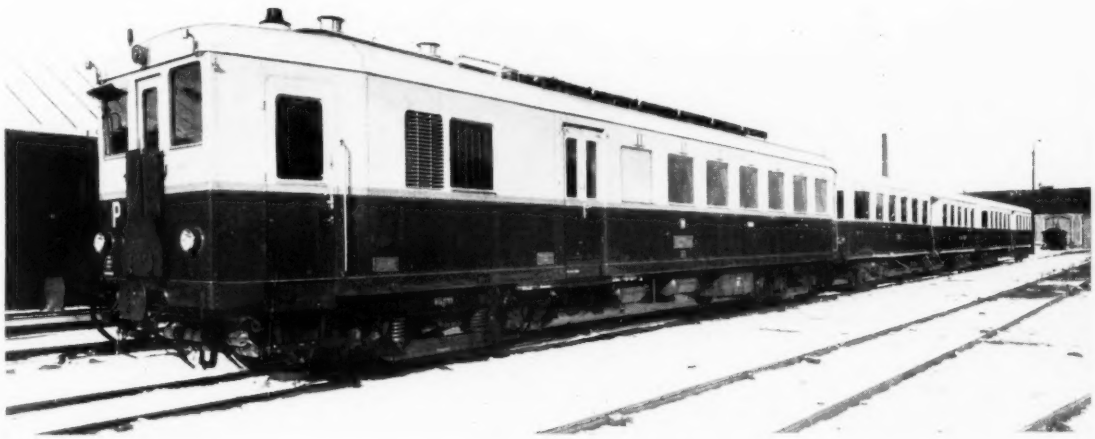


A 110 b.h.p. Ganz diesel car on the Danube-Save-Adriatic Railway, now merged in the Hungarian State Railways

THE BLUE ARROW

Diesel-electric interurban express train at work on the Czechoslovak State Railways

As a result of the experience gained with the 300 b.h.p. double-bogie diesel-electric railcars described in the *Diesel Railway Traction Supplement* for November 3, 1933, the Czechoslovak State Railways decided to apply diesel traction to those lines which carried the heaviest and fastest passenger traffic; and some three-car trains have just been set to work on a fast schedule between Prague and Bratislava. It is anticipated that by the end of the year similar services will be in operation on the Prague-Liberec, Prague-Teplice, Prague-Budejovice, and Prerov-Bratislava lines.



Three-car express diesel-electric train, The Blue Arrow, on the Czechoslovak State Railways

The service now in force between Prague and Bratislava is styled The Blue Arrow, and each train consists of a bogie diesel-electric motor coach and two double-bogie trailers. The motor coach has a driving position at each end, but no driving accommodation is provided in the trailers, and the motor coach must therefore run round the train at each terminal. The power and transmission equipment was supplied by the Ceskomoravska-Kolben-Danek Company, of Prague, and the mechanical portion of the motor coach and the complete trailers were built by the Ringhofferovy Zavody Company, of Smichov.

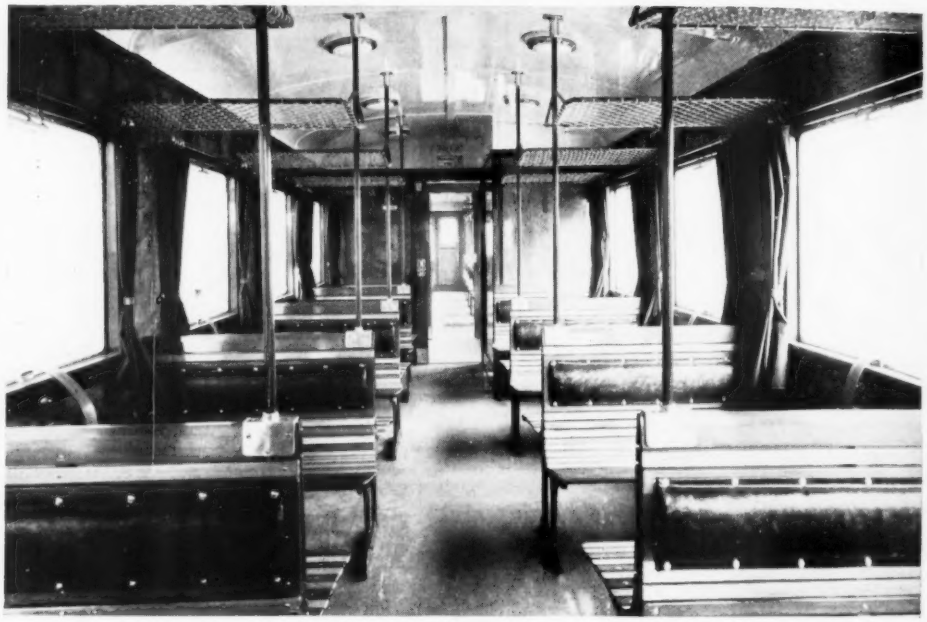
A somewhat different form of construction has been adopted for the motor coach compared with earlier vehicles, in that the ends of the body are slightly tapered and the roof rounded, reducing the air resistance somewhat at high speeds. The driving cabins have two side doors, and a door in the end with a hinged plate below, allowing the guard to pass from one vehicle to another. Entrance to the passenger saloon is gained through double doors situated in the luggage compartment behind the engine room and through single doors at the farther end. The car has a seating capacity of 64, and lavatory accommodation is provided.

The arrangement of the seats gives plenty of leg room and permits a free passage up and down the car. Above each pair of seats is a luggage rack with frames of light steel tubing. With a view to insulating the saloon as far as possible from noise and vibration, the floor is double and covered with rubber, on which is laid a green carpet. Both the side panels and transverse partitions are in veneered mahogany without any moulding or panelling, and the ceilings are enamelled white. All the windows are of the drop type with light metal frames and lights of semi-crystal glass, and they are fitted with sashed curtains of old gold colour. The frames and fittings of the windows, doors, roof lights and of the inside of the car generally are of polished light metal, and the grab handles at the doors are of non-corroding steel. Below the waist rail the bodies are painted a dark blue-grey colour, and above this level in light grey, and the underframe and bogies also are finished in the latter colour.

Electric welding has been used to join the various longitudinal and transverse members of the underframe, but the body is fixed to the chassis by means of rivets. The bogies are of the Brill type with side equalisers, and the cross stretchers and axlebox plates are welded to the main channel frames. Only one of the bogies is fitted with traction motors, the other acting merely as a carrier. All the wheels are of the spoked pattern and run in S.K.F. roller bearings. Automatic air braking of the Czechoslovak State Railways standard type, working in conjunction with a hand brake, applies two blocks on each wheel. Emergency application handles are provided in the passenger saloons, and a dead-man handle attachment is fitted to the electric control apparatus.

Power and Transmission Equipment

In the engine room is installed a six cylinder CKD-Hesselmann diesel engine developing a maximum rated output of 380 b.h.p. It is supported by the underframe and is directly coupled to a d.c. generator, which supplies current to the two 120-kW. traction motors. The electric control is of the Westinghouse type, manufactured by Ceskomoravska-Kolben-Danek under licence, and its characteristics permit of the full engine capacity being



Interior of motor coach as used on the diesel-electric train The Blue Arrow on the Czechoslovak State Railways between Prague and Bratislava

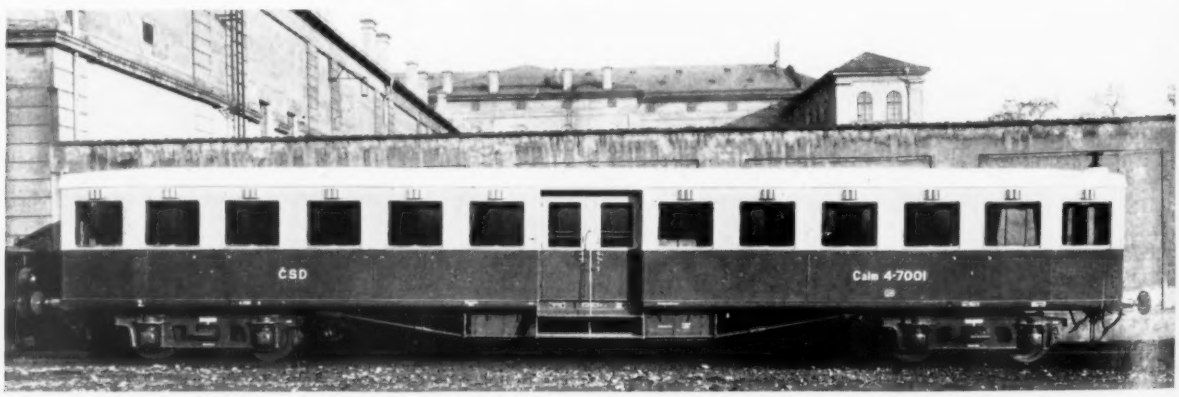
utilised at any road speed within the range of 12 and 75 m.p.h. Cooling of the engine circulating water and lubricating oil is effected in gilled tube radiators placed along the car roof. The passenger saloon is normally heated by passing through it the engine circulating water, but to heat the car up rapidly before starting on a journey, electric heaters are fitted, and receive their current from a storage battery which is charged by an auxiliary generator while the engine is running.

The main dimensions of these motor coaches, which are classified as M.275·0, are: Length over buffers, 62 ft. 6 in.; max. width, 9 ft. 8½ in.; pitch of bogies, 38 ft. 9 in.; bogie wheelbase, 8 ft. 2½ in.; diameter of driving wheels, 41 in.; diameter of carrying wheels, 39⅜ in.; max. speed, 75 m.p.h.; weight in running order, 46·2 tons; seating capacity, 64; b.h.p. per ton of car weight, 8·25; b.h.p per ton of train weight, 4·1.

Trailers

The construction of two trailers which complete the train differs in some respects from that of the motor coach, mainly in the matter of weight. Despite a length of over 67 ft. and a seating capacity of 81, each trailer scales only 23·7 tons, and the whole train tares only 93 tons for a seating capacity of 226. Large centre doors provide access to the interior of the trailer, which is divided into two large saloons, one for smokers and the other for non-smokers; lavatory accommodation is also incorporated. The seats and interior fittings are the same as those installed in the motor coach, but each trailer has its own independent electric lighting system supplied from a belt-driven dynamo and a battery. Heating is by means of electric stoves placed near the end of each compartment, and protected by screens.

Although the bogies are built up by welding, they are not of the same type as those fitted to the motor-coach, but are akin to the pattern used on the standard main-line passenger carriages of the Czechoslovak State Railways, with laminated bolster springs of flexible design. The Knorr air brake applies two blocks on each wheel, and emergency handles are fitted in each passenger compartment. Principal dimensions of the trailers are as follow: Length over buffers, 67 ft. 2 in.; width of body, 8 ft. 9 in.; pitch of bogies, 46 ft.; bogie wheelbase, 6 ft. 11 in.; diameter of wheels, 34½ in.; tare weight, 23·2 tons. The trailers are painted in the same style as the motor-coach, and in the State Railways stock list are classified as Calm.



One-class double-bogie trailer, forming part of new express diesel-electric train